BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **MME 323** (Physical Properties of Materials)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. An electron is in the *ground* state of a 1D infinite square well potential,

$$V(x)=\begin{cases}0 & 0\le x\le L\\ \infty & otherwise\end{cases}$$

(a) Write down the normalized wavefunction for this electron and its corresponding energy. What does a particle in box model and its solutions signify? **(13)**

(b) Now, at time t=0, the width of the well is suddenly doubled to 2L. Sketch the new potential well, and the wavefunction immediately after the change in length (before the wavefunction has time to change/evolve). If the electron energy is now measured, what is the probability that the result will correspond to the ground state energy of the new potential well? (Hint: Compute the inner product of the new and original wavefunction)

The following integral may be useful: $\int_0^{\pi}\sin(\theta)\sin(\theta/2)d\theta=\frac{4\sqrt{2}}{3}$ **(12)**

(c) Does the free space Hamiltonian (V=0) commute with momentum? Show how you arrived to your answer. **(10)**

2. (a) Calculate the wavelength, λ, of a photon capable of exciting an electron in He+ from the ground state to n = 4, ($K=2.18\times10^{-18}$ J/atom) **(10)**

(b) During your undergraduate thesis project, you have been upgraded from studying electrons in vacuum to studying electrons inside crystals. What are the major differences between the E-K plots in both cases and what do they signify? **(15)**

(c) Can Ge be used to make LEDs Explain your answer. **(10)**

3. (a) You decided to fabricate a Ge *pn*-junction for a photodetector. Pick appropriate dopants for *p* and *n* regions of your detector and draw the band diagram for the junction assuming twice the concentration of dopants on the *n*-side than the *p*-side. Indicate the built-in potential and the Fermi level in the diagram. Is the system in equilibrium or not? **(15)**

(b) Draw the charge density profile in the depletion region of the Ge pn junction. Is the width of the depletion region symmetric with respect to the position of the p and n materials' junction? How do you expect it to change when we apply a forward bias? How does it change under a reverse bias? **(15)**

Contd P/2

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Contd...Q.No. 3

(c) For a Si pn-junction with $N_A = 10^{17}$ cm^{-3}, $N_D = 10^{18}$ cm^{-3} and $n_i = 10^{20}$ cm^{-3} calculate the built-in voltage of the junction at 300K. **(5)**

4. (a) With the help of an energy band diagram explain inversion in an n-type MOSFET. **(15)**

   (b) Draw the characteristic I-V plot for a MOSFET showing what happens as the gate voltage changes. **(10)**

   (c) Given the table below, compare the conductivity of Ge and Ag. **(10)**

	μ_n (cm^2/Vs)	μ_p (cm^2/Vs)
Ge	3900	1900
Ag	50	-

SECTION – B

There are **EIGHT** questions in this section. Answer any **SIX**.

5. Clarify why barium titanate structure can store a large amount of charge compared to many other dielectric materials. Identify the frequency range in which polarization occurs for this perovskite crystal structure. Elucidate the shape of the hysteresis loops of barium titanate shown in Fig.1 for question no. 5 in relation to the crystal structure. **(17½)**

6. Reflectivity of a material is controlled by several factors such as ion size, crystal structure and crystallographic direction – argue this statement. State the origin of birefringence in many crystalline materials, unlike glass. **(17½)**

7. Describe how eh anti-reflection coating (ARC) functions for ARC material, like magnesium fluoride, when deposited as a film. Give explanation how both high and low index materials can be used as ARC materials. **(17½)**

8. Most dielectric ceramics and glasses are colourless because of their large optical band gap. Explain how the addition of transition and rare earth elements causes colour in such materials. State the reason why the scenario is a little more complicated for corundum. **(17½)**

9. The sequence of colourless, yellow, orange, red, and black is the precise range of colours available in the metal oxide semiconductors –defend this statement. **(17½)**

10. Quantum mechanical exchange interaction results in ferromagnetism and antiferromagnetism in metal oxides – justify this statement. Also, explain how exchange integral, J is calculated. **(17½)**

Contd P/3

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11. Distinguish between super exchange and double exchange mechanisms. Also, show how magnetic susceptibility varies with temperature for both paramagnetic and ferromagnetic materials. **(17½)**

12. Draw typical transmission spectra for an insulator and a semiconductor material along with detailed explanations of both the spectra. **(17½)**

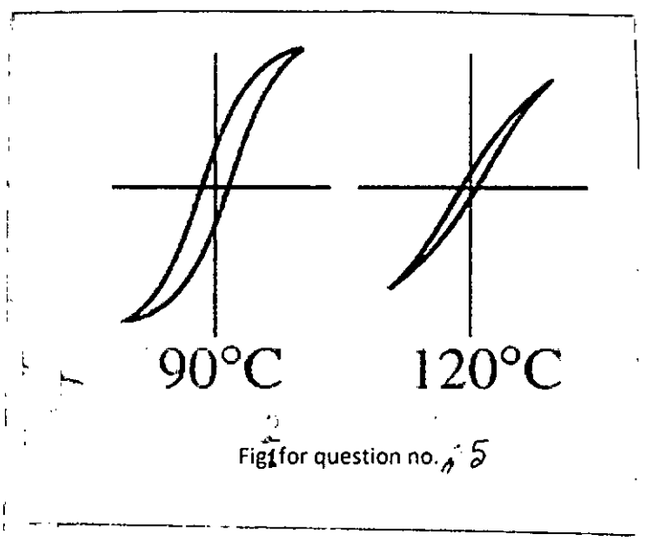

Fig for question no. 5

L-4/T-1/MME **Date : 01/10/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **MME 411** (Principles of Materials Characterization)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Propose the characterization methods with their applications that should be available in a modern materials characterization laboratory. **(15)**

   (b) Binary copper-nickel alloys have an alpha face-centred cubic crystal structure. Determine the six possible diffraction planes of copper-nickel alloys using structure factor. **(10)**

   (c) Apply the Ewald sphere method using the concept of the reciprocal lattice in the detection of crystal planes by X-ray diffraction. **(10)**

2. (a) Analyze quantitatively the crystallite size determination of nanomaterial phase with XRD. Calculate the crystallite size from the following X-ray diffraction peak generated from the X-ray having wave length 1.5406 A°. **(15)**

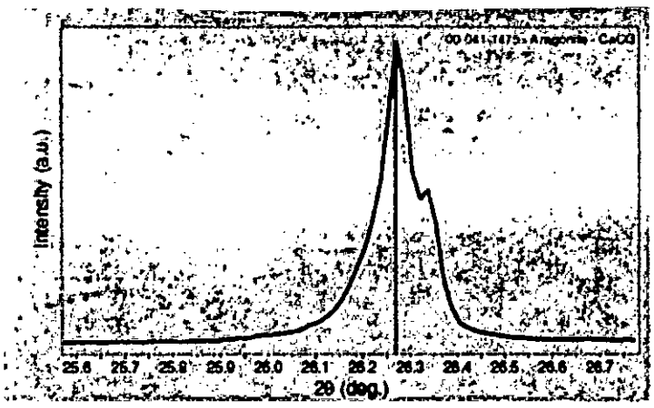

Fig. 1. for Question 2(a)

   (b) "Matching relative intensities, however, is not always possible even when the examined specimen has the same crystalline structure as the standard"- validate the statement. **(10)**

   (c) The bright field and dark field imaging modes are available in a typical transmission electron microscopy. Analyze critically the significance of both imaging modes. **(10)**

Contd P/2

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3. (a) You need to determine the crystal structure of nano size precipitates present in your sample. Select a most suitable method for the identification of the precipitates phase and justify your selection. Explain steps of the method. **(15)**

   (b) Explain how you will make a good scanning electron microscopy image by controlling the all operational variables. **(12)**

   (b) How will you determine the grain orientation and identify the phases of a plastically deformed metallic sample? **(8)**

4. (a) You need to know the bulk composition of a ceramic sample. Is it possible to measure the wt. percent of the oxides of your ceramic sample directly by XRF? If possible explain it. If not possible, is there any alternative for the determination of oxides composition of your sample by XRF? **(10)**

   (b) Select an EDS technique for the analysis of particular phase present in a multiphase sample. **(7)**

   (c) EDS spot analysis is performed in a sample. Two spot analyses are shown in Fig. 2. Determine the phases present in the sample. **(8)**

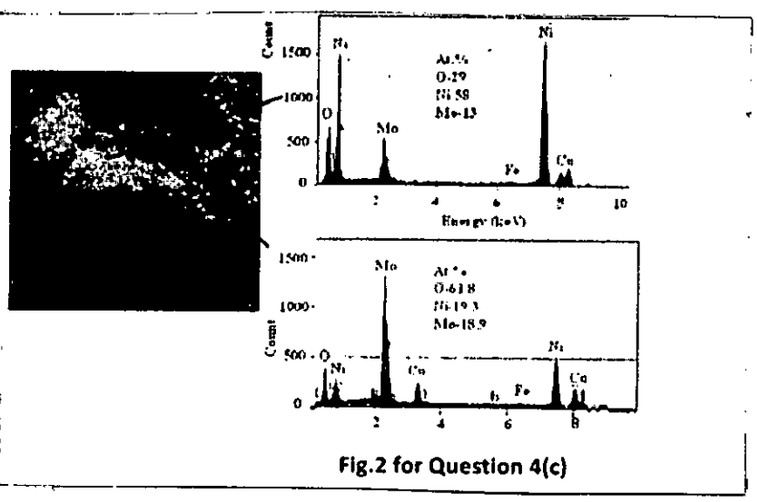

Fig.2 for Question 4(c)

   (d) "The most exciting function of a Scanning Tunneling Microscopy is its ability to image atoms." Explain this assertion. **(10)**

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SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

All the symbols have their usual meanings.

5. (a) Determine number of molecular vibrational modes present in CO_2. Sketch the vibrational motions. In the IR spectrum of CO_2 two intense peaks occur at 667 and 2349 cm^{-1}. How would you assign them with the vibrational modes? **(13)**

   (b) Which vibrational spectroscopies will work to identify organic non-light absorbing solutes in water? **(10)**

   (c) From UV-Vis spectroscopy, how do you distringuish two conjugate systems with having differences in number of double bonds? **(12)**

6. (a) The carbon KLL Auger electrons appear at an energy of 272eV on a kinetic energy scale when they are excited by a 3 KeV electron beam. What is the energy of the same carbon KLL Auger electrons if they are excited by a 5keV electron beam? **(10)**

   (b) The Auger electron transition is assigned by the x-ray notation KL_1L_2. Describe from which level the Auger electron comes from. Locate the primary electron vacancy and the electron vacancies after the Auger process. **(13)**

   (c) The intensity of Auger peaks is very small. Illustrate the most common way of presenting the Auger electron spectrum. **(12)**

7. (a) Recommend the best analytical method (with justification) to measure the 'Elemental composition of a bi-layered insulating optical thin film (each 5 nm thick). It is important to note that the thin film degrades with electron interaction. **(13)**

   (b) In SIMS energetic primary ions remove atoms, clusters, fragments from the surface. Elucidate how static SIMS can be considered as nondestructive surface analysis technique. **(12)**

   (c) Why Modulated DSC is used to measure the heat capacity of a material more accurately. **(10)**

8. (a) "The optical emission spectroscopy (OES) requires a certain pre-ignition time for the proper excitation of the sample before analysis". Validate the statement. **(11)**

   (b) Suggest with appropriate reasoning an NDT technique to detect a void of 0.4 mm in dimension in a 25 mm thick plastic sample. **(12)**

   (c) Calcium carbonate decomposes into calcium oxide and carbon dioxide when heated. How will you determine the decomposition temperature of calcium carbonate? Also mention the sampling and interpretation of output of your chosen instrumentation. **(12)**

L-4/T-1/MME **Date : 25/09/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **MME 443** (Physical Metallurgy of Steel and Heat Treatment)

Full Marks : 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

The questions are of equal value.

1. Where, why and how process annealing heat treatment is applied? A 3mm thick plain carbon steel hot rolled coil having 0.1%C is to be cold rolled for production of 75 μm thick colour coating sheet. Considering all aspects of cost and quality of the sheet products discuss what will happen if process annealing is done at points (1), (2) and (3) shown in **Figure 1 for Question No. 1**. For all cases schematically show detail changes in the fully cold rolled microstructures due to process annealing heat treatment.

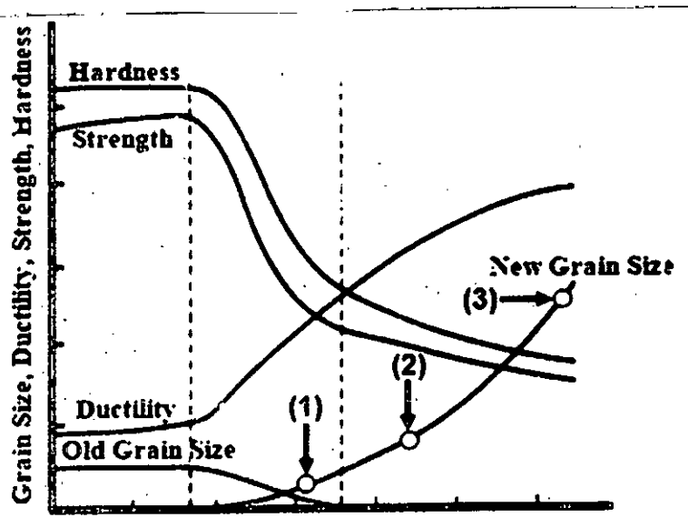

Figure 1 for Question No.1.

2. The microstructure of a plain carbon steel stock material is shown in **Figure 2 for Question No. 2.** After completion of hardening cycle, a triple phase microstructure **(Figure 3 for Questions No. 2)** is resulted. Explain the possible reasons of formation of this type of complex microstructures in the as quenched steel and suggest a heat treatment schedule for dual phase microstructures (any combination). Also calculate the residual stress level that that can be retained inside the as quencehed steel. Use data given in Table 1` if necessary. Assume reasonable value for any missing data.

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MME 443

Contd ... Q. No. 2

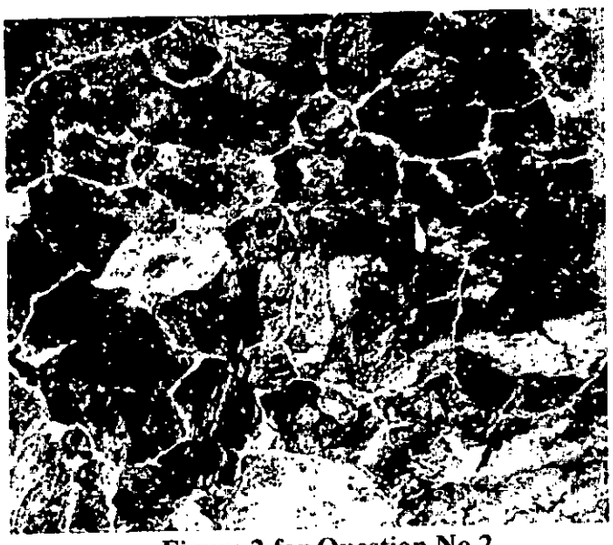

Figure 2 for Question No.2

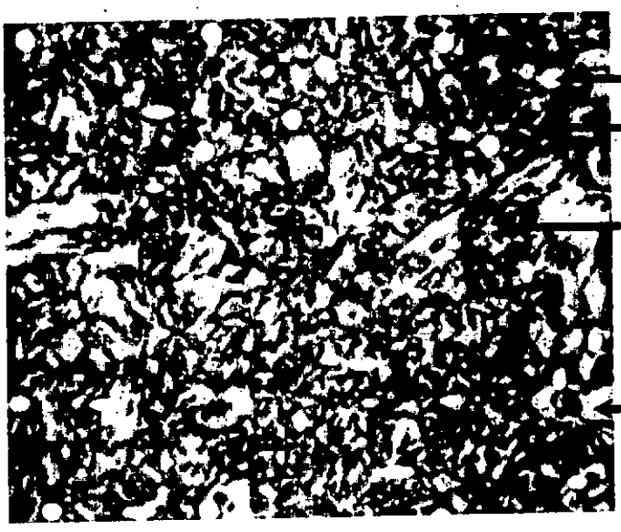

Figure 3 for Question No.2

Table 1 for Question No.2.

Phase	Apparent atomic volume, $Å^3$
Ferrite	11.789
Cementite	12.769
Ferrite + carbides	11.786 + 0.163 C(a)
Pearlite	11.916
Austenite	11.401 + 0.329 C(a)
Martensite	11.789 + 0.370 C(a)

(a) C = % carbon

Contd P/3

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3. Two similar size steel gears of different chemical compositions need to be hardened by quenching heat treatment. The M_s temperatures of these steel gears are, respectively, 100 and 330°C (Figure 4). With the help of information provided in **Figure 4 for Question No. 3** suggest suitable heat treatment schedules for them and select appropriate quench media of optimum bath temperature to make the heat treatment successful. If necessary, use information of **Figure 5 for Question No. 3** to select cooling media. Draw the final mocrostructures of these two as quenched gears.

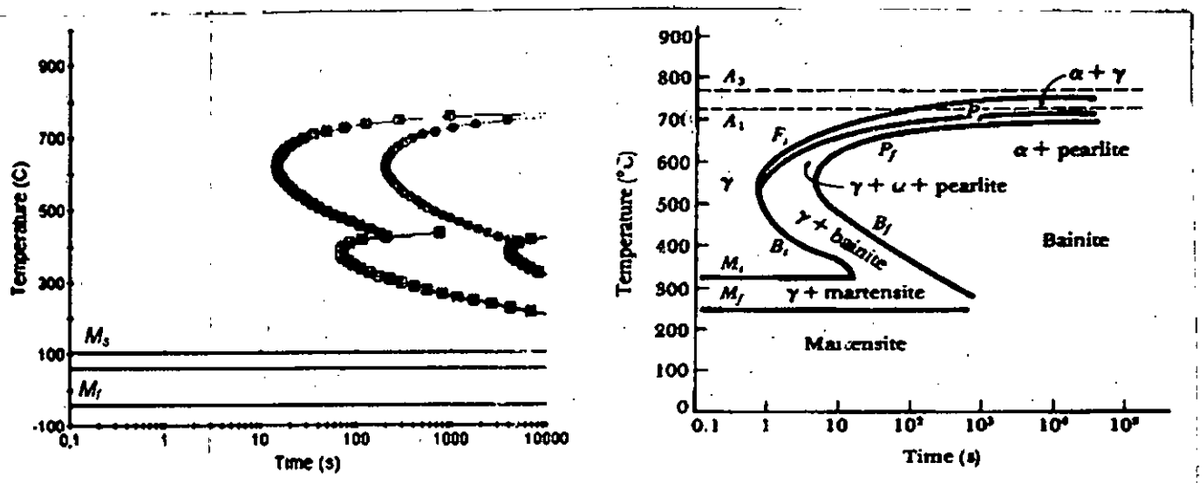

Figure 4 for Question No.3.

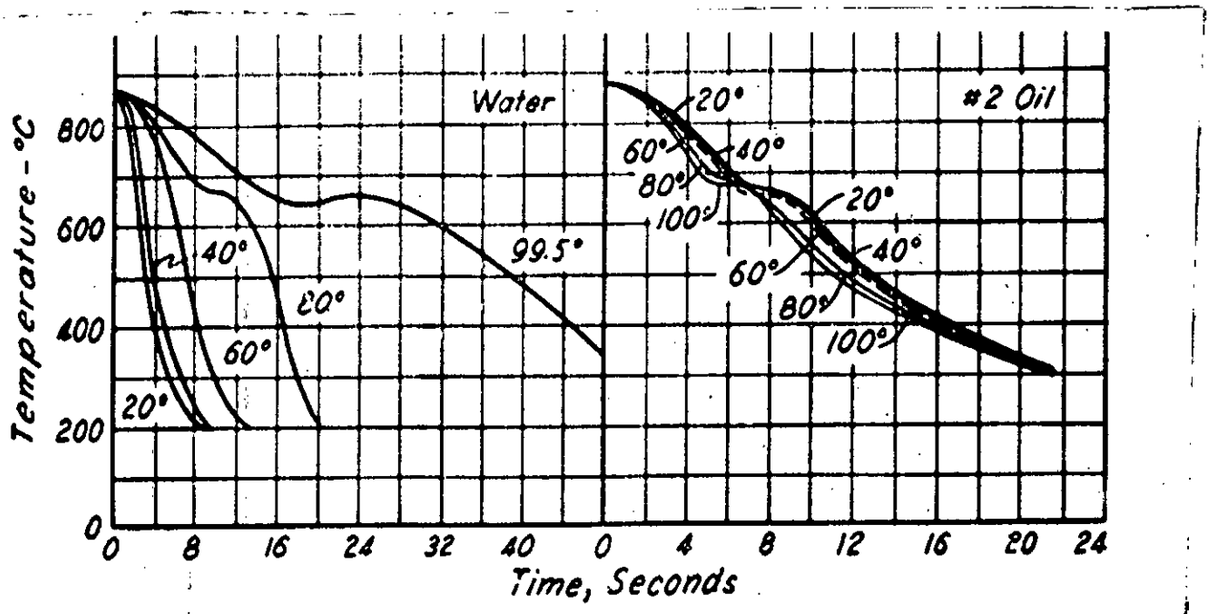

Figure 5 for Question No.3.

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MME 443

4. Manganese has a multi-dimentsional advantage as well as disadvantage when it remains present in steel. Mention three products and customize the manganese content in steel highlighting the dual behaviours of manganese content in steel so that opportunity for any deleterious effect could not be induced in real service conditions.

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Consider yourself as a materials engineer. You work in a surface treatment (by pack carburizing) plant, which is a part of a much larger integrated plant for casting and rolling of plain carbon steel (simple ball bearing parts). Your management has decided to introduce a different surface hardening technique, which they learn about while attending an international seminar abroad. They are excited about obtaining a very high hardness by using new techniques. They have shown you a comparison chart (See Figure 6). You disagreed with them from the technical and economical point of view.
After a long argument lasted for a few days, they finally agreed with you and stayed with pack carburizing method. How did you convince them? Build a systematic case using the following points: technological responsibilities; economical condition; relevance. **(17½)**

(b) Why does carburized steel parts require hardening? Design diagrams of hardending following by tempering schedules for these parts and generate your concept on the selection of temperature of hardening. **(17½)**

6. (a) Draw a composition map showing ranges of different types of cast iron based on carbon and silicon contents.
Also, draw as-cast microsturctures of these cast irons. Create a table discussing the reasons for having difference in microstructures. **(5+5+7½)**

(b) Annealing treatment of gray cast iron and nodular cast iron are completely different. Formulate the reasons behind different schedules of these two materials. How does austenisation temperature affect desired hardness level obtainable after quench-hardening? **(10+7½)**

7. (a) For developing a tool steel for drilling purposes in a coal mine, which two of the following properties would be most crucial?
Resistance to Wear; hardness; toughness; Resistance to Thermal Fatigue.
Judge your answer in terms of mechanical properties. **(17½)**

(b) The microstrucute of annealed tool steels consists of ferrite and carbides. The nature of these carbides depends on the chemical composition of the steel. As the performance of tools depends on the morphology and volume fraction of carbides, the control of these two parameters is a very tricky game in the case of heat treatment of tool steels.
Grade the carbides in terms of performance (consider hardness only).

Contd P/5

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Contd. Q. No. 7(b)

Draw their characteristic microstructures and evaluate the reasons for these carbides having differing hardness values. **(17½)**

8. (a) Explain softening and hardening tendency of high-speed steel during tempering. Also, categorise the four classes of quenched tool steel based on variation of hardness with tempering temperature. **(10+5)**

(b) Schematically show the effects of carbon and chromium on the gamma phase portion of Fe-C-Cr ternary diagram. **(5)**

(c) What is precipitation hardenable stainless steel? Why do we need this different class of stainless steel? How does the hardening occur in this alloy? **(5+5+5)**

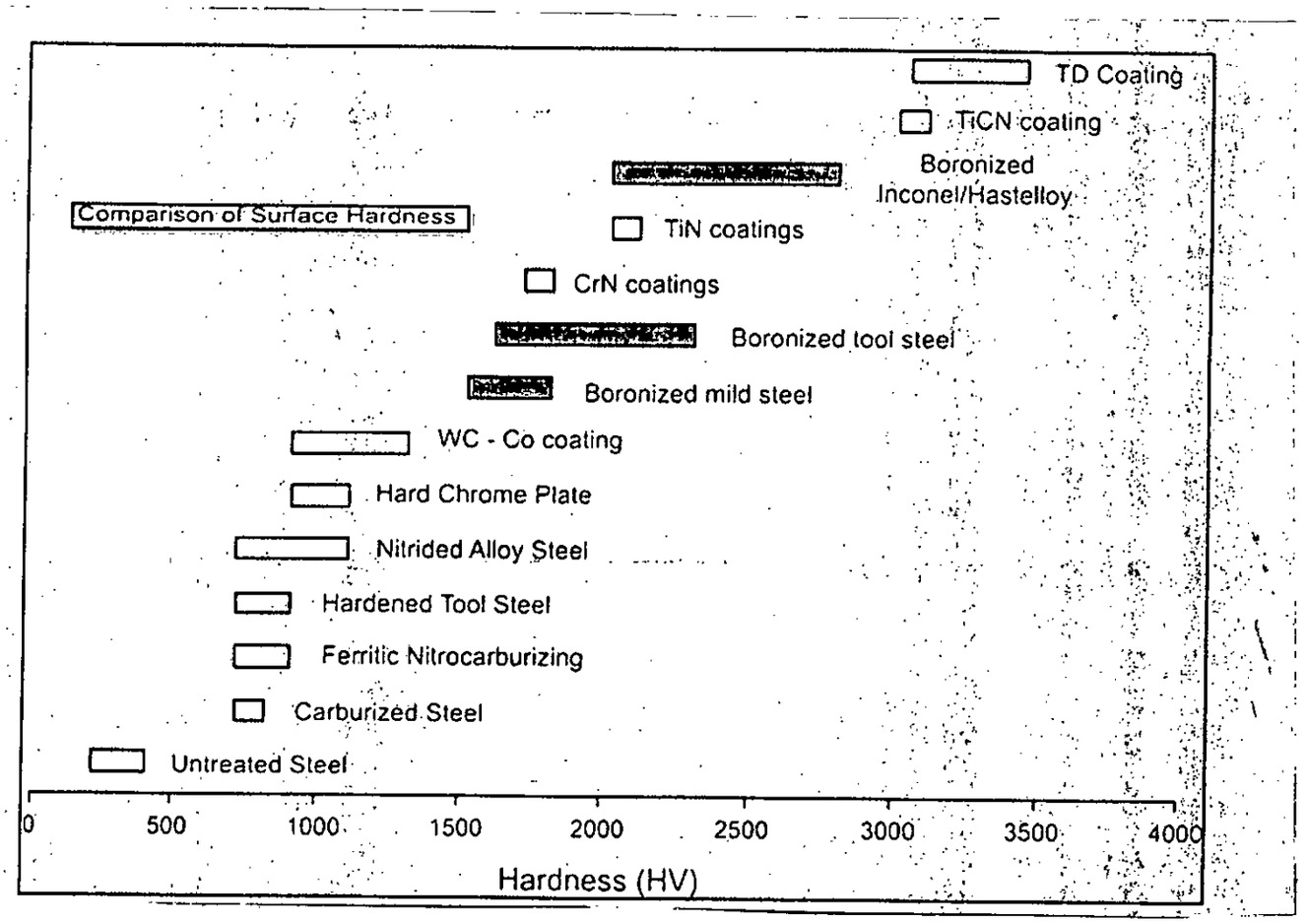

Figure 6 Hardness achieved from various surface hardening techniques

L-4/T-1/MME **Date : 26/10/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **MME 475** (Polymers and Composites)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Design a suitable polymer processing technique for producing multiple polypropylene boxes. **(25)**

   (b) Addition polymerization increases density. Explain how this increased density affect mechanical properties of the final product. **(10)**

2. (a) Differentiate between branched polymer and linear polymer. **(12)**

   (b) An industry requires a polymer with high strength and stiffness, excellent thermal stability and good chemical inertness. Suggest a polymer with proper justification. **(14)**

   (c) The density of two polypropylene materials are 0.904 g/cm^3 and 0.895 g/cm^3 respectively, while the associated percent crystallinity of those two materials are 62.8 and 54.4 respectively. Calculate (i) densities of totally crystalline and totally amorphous polypropylene and (ii) density of a specimen having 74.6% crystallinity. **(9)**

3. (a) Select a suitable polymer for manufacturing aero plane dashboard. Place argument in favour of your selection. **(14)**

   (b) Explain how creep behaviour of polymeric material is different from that of metallic material. **(12)**

   (c) Two monomers of same proportion are polymerized to form a block co-polymer and a graft co-polymer separately. Among these two co-polymers, which one has higher density? Justify your answer. **(9)**

4. (a) Select and outline a suitable manufacturing process for plastic bottle production. **(17)**

   (b) What is dual sheet thermoforming? Why is dual sheet thermoforming preferred for plastic production? **(10)**

   (c) Mention the roles of flame retardant and plasticizer in enhancing properties of polymer. **(8)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Development of ceramic matrix composite is not moving forward as fast as polymer matrix composite" – discuss. **(15)**

Contd P/2

MME 475

Contd...Q. No. 5

(b) Prescribe a characterization process to reveal the interfacial shear strength of a composite. **(10)**

(c) It is well known that ceramics are brittle and polymers are ductile. However, SiC and Nylon 6.6 have the same fracture toughness (K_C) value of 3 MPa$\sqrt{m}$ – Explain why. **(10)**

6. (a) Composite synthesized by spray-up method should be followed by rolling – Validate the statement. **(10)**

(b) Describe a suitable metal matrix composite manufacturing technique with controlled fiber alignment. **(10)**

(c) In general, Sol gel is a useful technique to produce ceramic nanopowders. Discuss how this technique can be utilized to make ceramic matrix composites. **(15)**

7. (a) Discuss the importance of critical fiber length on the load bearing capacity of a composite material. **(10)**

(b) Design a structural component with fiber reinforced polymer composite only for uniaxial loading. **(10)**

(c) Discuss how high-strength brittle fiber increases the overall toughness of a reinforced composite. **(15)**

8. (a) To develop a light weight high strength high temperature sustainable fiber reinforced composite, the choice of fiber material is limited. Suggest a possible candidate of fiber material with reasoning. **(18)**

(b) Among the materials listed in Table 1, recommend a possible combination of matrix and reinforcement to produce a composite for the application in high temperature cycling condition. Give reasoning behind your answer. **(17)**

Table 2 *Selected properties for different types of matrix materials*

Matrix	Density ρ (Mg m^{-3})	Young's modulus E (GPa)	Poisson's ratio ν	Tensile strength σ_* (GPa)	Failure strain ϵ_* (%)	Thermal expansivity α (10^{-6} K^{-1})	Thermal conductivity K (W m^{-1} K^{-1})
Thermosets							
epoxy resins	1.1–1.4	3–6	0.38–0.40	0.035–0.1	1–6	60	0.1
polyesters	1.2–1.5	2.0–4.5	0.37–0.39	0.04–0.09	2	100–200	0.2
Thermoplastics							
Nylon 6.6	1.14	1.4–2.8	0.3	0.06–0.07	40–80	90	0.2
polypropylene	0.90	1.0–1.4	0.3	0.02–0.04	300	110	0.2
PEEK	1.26–1.32	3.6	0.3	0.17	50	47	0.2
Metals							
Al	2.70	70	0.33	0.2–0.6	6–20	24	130–230
Mg	1.80	45	0.35	0.1–0.3	3–10	27	100
Ti	4.5	110	0.36	0.3–1.0	4–12	9	6–22
Ceramics							
borosilicate glass	2.3	64	0.21	0.10	0.2	3	12
SiC	3.4	400	0.20	0.4	0.1	4	50
Al_2O_3	3.8	380	0.25	0.5	0.1	8	30

L-4/T-1/MME **Date : 20/10/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **IPE 491** (Engineering Management)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

Assume appropriate values for any missing data.

1. (a) List the types of Needs in Marketing. Provide one example for each of the types. **(5)**

   (b) A company projects its total sales and profits through plans for existing businesses. The projected sales are less than what management desires. What are the growth opportunities you will suggest this company to explore in order to minimize the gap between projected sales and desired sales? Explain with suitable example. **(15)**

   (c) Define the possible demand states and relates the following instances to appropriate demand states. **(15)**

Examples	Demand State
Demand for an umbrella.	?
Demand for flying cars in Dhaka city.	?
Demand for Walkman for listening songs	?
Demand for Health insurance.	?
Demand for cigarettes.	?
Demand for bus/train tickets at the time of Eid	?

2. (a) The newly appointed maintenance manager of one unit of a pharmaceutical company is trying to figure out the essentiality of preventive maintenance in the production unit. He conducted a study last month and found that in one month period total 6 breakdowns (each with a downtime of 3 days) occurred that costs 2500 BDT per breakdown. If inspection-based preventive maintenance facility is built, the total cost of preventive maintenance system will be 8750 BDT/month. Esch inspection requires a downtime of 1.5 days. As an expert, your task here is to help the manager with the following questions. **(10)**

   (i) Is preventive maintenance justified for the production unit according to the last month data?

   (ii) If justified, find out the optimum number of inspections for a month. Assume the constant c, associated with the production facility to be 3.

Contd P/2

IPE 491

Contd...Q.. No. 2

(b) Four mutually exclusive alternatives are being evaluated, and their costs and revenues are itemized below. If the MARR is 15% per year and the analysis period is 12 years, draw the cash-flow diagrams and use the Present Worth (PW) and External Rate of Return (ERR) methods to determine which alternatives are economically acceptable. Also find out which alternative should be selected finally. **(25)**

	Mutually Exclusive Alternative			
	I	II	III	IV
Capital investment	$100,000	$152,000	$184,000	$220,000
Annual revenues less expenses	15,200	31,900	35,900	41,500
Market value (end of useful life)	10,000	0	15,000	20,000
Useful life (years)	12	12	12	12

3. (a) Mention the differences between Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM). **(3)**

(b) Define centralized and decentralized maintenance. Mention the limitations of centralized maintenance. In large plants, which maintenance normally works best? **(5)**

(c) List the types/elements of preventive and corrective maintenance. **(12)**

(d) For the following task table, calculate the maintenance project duration and find the critical path. **(15)**

Task	Successor	Duration (days)		
		Optimistic	Most Likely	Pessimistic
I	----	5	6	7
B	D	2	3	4
F	H, I	7	8	9
C	E, F	3	4	5
H	----	5	6	7
D	F, G	5	6	7
A	C	4	5	6
E	H	6	7	8
G	I	7	8	9

4. (a) Calculate the Economic Order Quantity (EOQ) for the following data: **(15)**

Annual demand = 800 units

Ordering cost = $ 9/order

Inventory carrying cost = 20% of cost per unit

Contd P/3

IPE 491

Contd...Q.. No. 4

Cost per unit= $ 18 for lot size 1 ~ 49

= $ 17.75 for lot size 50 ~ 99

= $ 17.5 for lot size 100 ~ 149

= $ 17.25 for lot size 150 ~ 199

= $ 17 for lot size 200 ~ up

(b) 'XYZ' company manufactures a wide range of products at several plant locations. The plant manufactures office appliances and has been experiencing difficulties with fluctuating monthly overhead costs. The fluctuations have made it difficult to estimate the overhead costs. Management is trying to find out the factors on which the overhead cost actually depends. Machine Hour is being considered as a prime factor. As an endeavor to prove that they have collected a set of historical data as shown in the following table. **(20)**

Month	Machine Hour	Overhead Costs (BDT)
January	20,050	86,000
February	27,000	99,900
March	23,000	90,500
April	23,700	94,000
May	20,900	84,500
June	19,600	77,500
July	14,300	73,500
August	11,000	68,500
September	14,000	69,900
October	17,800	77,000
November	16,100	72,500
December	19,600	79,000

Now they want you to answer the following questions.

(i) Using regression analysis, determine the cost formula for overhead cost as a function of Machine hour.

(ii) For any month, machine hour in the plant is found to be 29,600 hours. What will be the expected overhead cost?

Contd P/4

IPE 491

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

A Normal Distribution Chart is provided. Assume an appropriate value for missing data.

5. (a) Describe the path-goal model of leadership. On what theory of motivation is the model based on? What factors, according to this theory, help to determine the most effective leadership style? **(12)**

   (b) Task Structure and positional Power have an impact on leadership. What theory is that and how do they affect leadership? **(10)**

   (c) Mention the relative advantages and disadvantages of different performance appraisal methods. **(8)**

   (d) What are the different types of "justice" as per the Equity theory of motivation? Explain. **(5)**

6. (a) Differentiate efficiency and effectiveness with suitable examples in the view of a manager. **(5)**

   (b) Why is the organizational structure important? Would you rather work in a mechanistic organization or an organic organization? Justify your answer. **(10)**

   (c) Name three different skills of a manger to perform his job successfully. How can you relate these skills of different management levels with the level of importance? **(10)**

   (d) Discuss the advantages of delegation. Why do managers hesitate to delegate? Explain the key guidelines for effective delegation. **(10)**

7. (a) Explain the routes of chemical exposure to a worker in the process industry. **(5)**

   (b) Describe the risks of confined space. Suppose you are working as an EHS Manager. Design a safety protocol for workers while working in confined spaces. **(10)**

   (c) An automobile battery manufacturer produces 10000 batteries per day. The quality control expert in the plant planned to take samples of size 70 units for every working day. The plant operates 22 days in a month. A quality inspector randomly collected and tested 70 batteries per day. The batteries will be either conforming or non-conforming. Which control chart should you select for the following information and explain whether the process is stable or not. **(20)**

Contd P/5

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Contd...Q.. No. 7(c)

Sample no	No of non-conforming	Sample no	No of non-conforming
1	6	12	8
2	9	13	5
3	1	14	5
4	5	15	5
5	8	16	4
6	7	17	3
7	9	18	2
8	4	19	2
9	3	20	8
10	10	21	6
11	8	22	4

8. (a) The following data were obtained by observing a job of a financial manager's assistant. **(5+5+5)**

(i) Using the data and an allowance of 10 percent of job time, determine a standard time for each element.

(ii) Determine the number of observations that would be required to estimate the mean time for the first element within 4 percent of the true value with a confidence of 98 percent.

(iii) How many observations would be needed to estimate the mean time for element B to within 0.10 minutes of its actual value with a confidence of 90 percent?

	Observation (Minutes per Cycle)					
Element	Performance Rating (%)	1	2	3	4	5
A	90	1.40	1.42	1.39	1.38	1.41
B	120	2.10	2.05	2.00	1.85	1.80

(b) A shop works 400 minutes/day. The manger of the shop wants an output of 200 units per day for the assembly line that has the elemental tasks shown in the table. Do the following: **(6+10+4)**

(i) Construct the precedence diagram.

(ii) Determine the minimum number of workstations required and assign tasks to workstations using this rule: Assign tasks according to the greatest number of following tasks. In case of a tie, use the tiebreaker of assigning the task with the longest processing time first.

(iii) Calculate the percentage idle time for the line and compute efficiency.

Contd P/6

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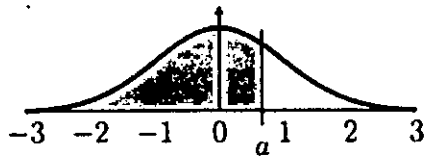
Contd...Q.. No. 8(b)

Task	Immediate Predecessor	Task Time (Minutes)
A	-	0.5
B	A	1.4
C	A	1.2
D	A	0.7
E	B, C	0.5
F	D	1.0
G	E	0.4
H	G	0.3
I	F	0.5
J	E, I	0.8
K	H, J	0.9
M	K	0.3

1. z-TABLE: NORMAL DISTRIBUTION—CUMULATIVE PROBABILITIES

The shaded area in the graph is $P(z \leqslant a)$, which is what you would find if you looked up a in the table.



$$z = \frac{x - \mu}{\sigma}$$

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8079	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9983	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.99952	0.99953	0.99955	0.99957	0.99958	0.99960	0.99961	0.99962	0.99964	0.99965
3.4	0.99966	0.99968	0.99969	0.99970	0.99971	0.99972	0.99973	0.99974	0.99975	0.99976
3.5	0.99977	0.99978	0.99978	0.99979	0.99980	0.99981	0.99981	0.99982	0.99983	0.99983
3.6	0.99984	0.99985	0.99985	0.99986	0.99986	0.99987	0.99987	0.99988	0.99988	0.99989
3.7	0.99989	0.99990	0.99990	0.99990	0.99991	0.99991	0.99992	0.99992	0.99992	0.99992
3.8	0.99993	0.99993	0.99993	0.99994	0.99994	0.99994	0.99994	0.99995	0.99995	0.99995
3.9	0.99995	0.99995	0.99996	0.99996	0.99996	0.99996	0.99996	0.99996	0.99997	0.99997